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Science, Innovation and Electronic Information Division

Innovation in Selected Transportation Industries: Results from the Survey of Innovation 2003

2001-2003

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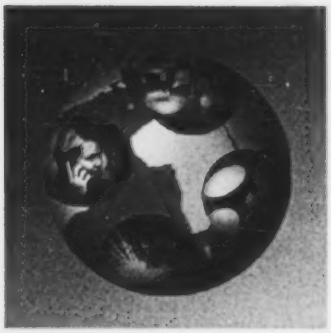

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^{p} preliminary
^{r} revised
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Note
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Statistics Canada
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Innovation in Selected Transportation Industries: Results from the Survey of Innovation 2003

2001-2003

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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

The Science and Innovation Information Program

The purpose of this program is to develop **useful indicators of science and technology activity** in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors**: are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities**: include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages**: are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes**: are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts**: are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report **Federal Scientific Activities, 1998 (Cat. No. 88-204)** first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (**Science and Technology Activities and Impacts: A Framework for a**

Statistical Information System, Cat. No. 88-522). The framework has given rise to **A Five-Year Strategic Plan for the Development of an Information System for Science and Technology** (Cat. No. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193.

Table of Contents

Acknowledgements 7
Executive Summary 8
Preface 10
Introduction 11
The Survey of Innovation 2003 11
1. What is innovation? 13
Rates of innovation 14
Types of innovation 15
Novelty of innovation 17
2. How does innovation take place? 18
Sources of information for innovation 19
Innovation activities 22
Where innovations are developed 23
Innovation collaboration 25
Not yet completed or abandoned innovation activities 27
3. What are the obstacles to innovation and the support programs for innovation? 28
Problems and obstacles to innovation 29
Government support programs 32
4. What are the impacts of innovation? 34
5. Why do some establishments choose not to innovate? 35
Appendix I: Description of transportation industries 37
Appendix II: Detailed data tables 38
Appendix III: Overview of transportation industries 60
How to order catalogued publications 65

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Finally, the author would also like to thank the 2,123 selected services establishments who completed the questionnaire. Without their cooperation and goodwill, this working paper would not have been possible.

Executive Summary

Incidence and types of innovation

Rates of innovation in selected transportation industries ranged from a high of 53% in "Rail transportation" establishments to a low of 21% in "Water transportation" establishments.

In six of seven selected transportation industries, innovators were more likely to develop process innovations than product innovations. The exception was "Interurban and rural bus transportation" where there were more establishments engaged in product innovation than process innovation.

Novelty of innovation

Innovative "Air transportation" establishments reported the highest percentage of Canada-first innovations (39%) while innovative "Airport operations" establishments reported the most world first innovations (16%).

Sources of information

Sources of information for innovation are most commonly: management staff; suppliers of software, hardware, materials, or equipment; the Internet; and clients or customers.

Innovation activities

Acquisition of equipment and machinery, and training were the most frequently indicated activities associated with the introduction of innovative products or processes by all of the selected transportation industries.

Where innovations are developed

Who developed product innovations varied markedly by industry but generally, product innovations were developed either mainly within the business unit or the firm they are part of, or in co-operation with other firms or organizations.

Co-operation and collaboration

The proportion of establishments engaging in collaboration and the reasons for collaboration varied amongst the selected transportation industries.

Problems and obstacles to innovation

Establishments in each selected transportation industry indicated a variety of obstacles to innovation arising from economic factors, factors internal to the firm and other factors, but the mix of obstacles varied by industry. Amongst the three categories of factors, economic factors were indicated by the highest percentage of innovative establishments as important problems and obstacles.

Government support for innovation
Use of government R&D support programs, either R&D tax credits or R&D grants, were reported by less than 10% of all innovative establishments in each of seven selected transportation industries. Use of other types of government support programs was generally higher, with use of government information or internet services indicated by at least 20% of establishments in all selected transportation industries.

Impacts of innovation
The most common results of innovation for the selected transportation services industries included: increased productivity; increased speed of supplying and/or delivering services or goods; increased ability to adapt flexibly to different client demands; keeping up with one's competitors; and improved quality of products.

Reasons firms do not innovate
Lack of market demand was the most frequently indicated reason for not developing innovative products for selected transportation industries for which reliable data are available.

Preface

Innovation and the adoption and dissemination of innovative technologies and practices are vital to economic growth and development. It is through innovation that new products are introduced to the market, new production processes are developed and introduced, and organisational changes are made. Through the adoption of newer, more advanced, technologies and practices, industries are able to increase their production capabilities, improve their productivity, and expand their lines of new goods and services.

In 1993, the first survey of innovation and the adoption of advanced technologies in the Canadian manufacturing sector was carried out at Statistics Canada. It was followed by a survey of innovation in the communications, financial services and technical business services industries, conducted by the Science, Innovation and Electronic Information Division (SIEID) in 1996. The Survey of Innovation, 1999 surveyed manufacturing industries and, for the first time, selected natural resource industries. The Survey of Innovation, 2003 focused on innovation activities in selected services industries, including all of the industries belonging to the information and communications technology (ICT) services sector, as well as selected professional services, selected transportation services and selected natural resource support services industries.

SIEID carried out biotechnology surveys in 1996, 1997, 1999, 2001 and 2003, which examined both the development of new biotechnology products and processes, and the use and planned use of biotechnologies. The Bioproducts Development Survey was also conducted in 2003. The 1999 Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries was the first survey of its kind for the construction sector. A number of other surveys have focused on the use and planned use of advanced technologies and practices, including the Surveys of Advanced Manufacturing Technologies (1987, 1989, 1993 and 1998), and surveys on the use and planned use of information and communications technologies, carried out annually since 1999.

This working paper, on innovation in selected transportation industries, is one of a series of four descriptive working papers which provide an overview of the results of the Survey of Innovation 2003, and is part of a series of products that will present and analyse the data from this survey.

Introduction

Innovation may be thought of as the transformation of knowledge into economic activity, a continuum running from invention to commercialization (bringing the new product to the market or the new process to the workplace). From this perspective, innovation performs a vital role contributing to economic growth and development. Through innovation, new products are introduced into the marketplace, new production processes are developed and organizational changes are made.

Under the North American Industry Classification System (NAICS), transportation is a distinct sector (NAICS 48). The sector accounted for 4.0% of GDP in 2003. Some transportation industries, such as "Truck transportation" reported strong growth, while others such as "Air transportation" declined. The transportation sector accounted for 3.5% of all employment, with "Truck transportation" accounting for the largest share of jobs. Wages and salaries in this sector range from a level comparable to the average to well above average[1].

This paper is divided into five sections and three appendices. The first section will examine the nature of innovation; the second will describe how innovation takes place. The third section will explore factors that may impact the decision to innovate such as obstacles and incentives. The fourth section will examine the impacts of innovation. The fifth section will look at why some firms chose not to innovate. Finally, three appendices will provide the NAICS (North American Industry Classification System) description for each of the industries covered in this paper, tables containing estimates with reliability measures for all data included in this paper and an overview of transportation industries in terms of their contributions to GDP, employment and R&D spending.

The Survey of Innovation 2003

The data used in this paper are from the Survey of Innovation 2003. The Survey of Innovation 2003 is the first survey of innovation in Canada to examine industries in the transportation sector, however innovation in the transportation equipment manufacturing industries was covered in the Survey of Innovation 1999[2].

This survey was conducted pursuant to the guidelines set out in the Oslo Manual[3]. The target population for the Survey of Innovation 2003 was establishments operating in Canada in selected service industries including all ICT[4] industries in the service sector; selected knowledge-based "Professional, scientific and technical services" industries; industries serving mining and/or forestry or forest products; and selected "Transportation

1. More detailed information on the transportation sector is found in Appendix III.
2. Statistics Canada (2002), Survey of Innovation 1999, Statistical Tables, Manufacturing Industries, Cat. No. 88F0006XIE2002016
3. OECD/Eurostat (1997), *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual)*. Paris: OECD
4. The definition of Information and communications technology (ICT) industries is found on the Statistics Canada web site: http://www.statcan.ca/english/Subjects/Standard/spec-aggreg/ict-2002/ict02-menu.htm.

industries". To reduce the response burden on small businesses, only establishments with at least 15 employees and at least $250,000 in revenues[5] were considered in sample selection[6].

The questionnaire was directed to establishments. "The establishment is the level at which the accounting data required to measure production is available (principal inputs, revenues, salaries and wages). The establishment, as a statistical unit, is defined as the most homogeneous unit of production for which the business maintains accounting records from which it is possible to assemble all the data elements required to compile the full structure of the gross value of production (total sales or shipments, and inventories), the cost of materials and services, and labour and capital used in production."[7] In the questionnaire, establishments were referred to as "business units" as this terminology was found to be more familiar to respondents completing the survey. Establishments were also asked whether or not they belonged to larger firms, which corresponds to the statistical concept of the enterprise.

Seven selected transportation industries were sampled, with 538 sampled establishments representing a total of 3,311 establishments. Table 1 contains a detailed breakout of population, sample and response rate by industry.

Table 1: Population, sample and response rate for selected transportation industries

NAICS (2002)	Description	Population	Sample	Response rate (%)
481	Air Transportation	253	114	55.1
482	Rail Transportation	42	41	45.5
483	Water Transportation	110	78	72.7
484	Truck Transportation	2,754	168	73.2
4852	Interurban and Rural Bus Transportation	48	45	40.0
48811	Airport Operations	72	60	82.0
48831	Port and Harbour Operations	32	32	96.7

Source: *Statistics Canada, Survey of Innovation 2003*

5. Revenues and number of employees were obtained from Statistics Canada's Business Register, December 2002.
6. Details on the Survey of Innovation 2003 are available on the Statistics Canada web site: http://www.statcan.ca/english/sdds/4218.htm
7. Source: http://www.statcan.ca/english/concepts/stat-unit-def.htm

1. What is innovation?

Innovation combines invention and discovery with practical application, either by bringing the invention to the market or to the workplace. The Oslo Manual[8] outlines proposed guidelines for collecting and interpreting innovation data and allows the production of internationally comparable, meaningful indicators of innovation. The manual identifies two types of technological innovation — product innovation and process innovation.

An innovative firm is one that has introduced a new or significantly improved product onto the market or introduced a new or significantly improved process into the production process during the previous three years.

In the case of product innovation, the product must be new to the establishment and it must have been introduced to the market, and not simply be ready for introduction to the market. The term "product" includes both goods and services. Complex products may be innovative as a result of changes to one of the components or subsystems. Changes to a firm's existing products that are purely aesthetic, or that involve only minor modifications, are not considered to be innovations.

A process innovation must have been actually used within the production process. New or significantly improved processes are those that are new to the firm. The outcome of process innovation should be significant with respect to the level of output, quality of products (goods or services) or costs of production and distribution. Minor or routine changes to processes are not to be included. The term "process" also includes improved ways of delivering goods or services.

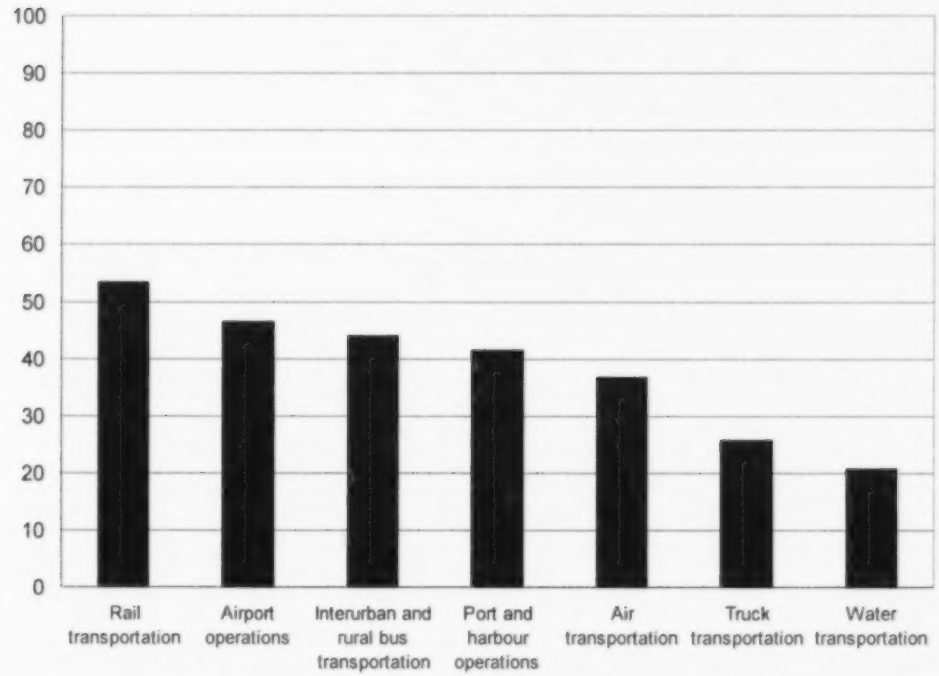
This section will look at the percentage of innovators, the type of innovation being undertaken and the degree of novelty of innovations in selected transportation industries.

8. OECD/Eurostat (1997), *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual)*. Paris: OECD.

Rates of innovation

A minimum of one in five establishments in each selected transportation industry were innovative (Figure 1). "Rail transportation" reported the highest percentage of innovators, with 53% of establishments indicating that they had introduced a new or significantly improved product or process. "Water transportation" establishments reported the lowest proportion of innovators amongst selected transportation industries with 21% reporting they had introduced a new or significantly improved product or process.

Figure 1
Percentage of innovative establishments, 2001 to 2003

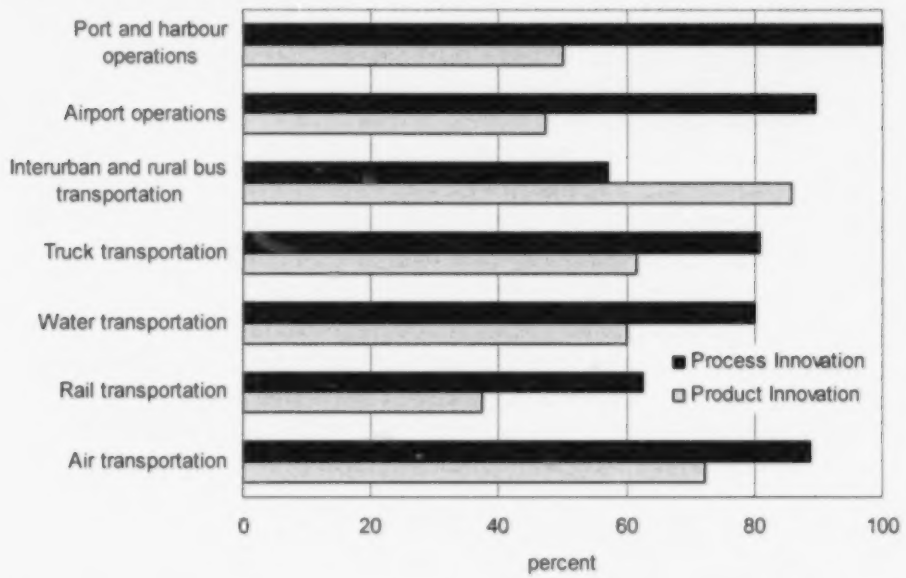


Source: *Appendix II, table 1A*

Types of innovation

In six of seven selected transportation industries, innovators were more likely to develop process innovations than product innovations (Figure 2). The exception was "Interurban and rural bus transportation" where there were more establishments engaged in product innovation than process innovation.

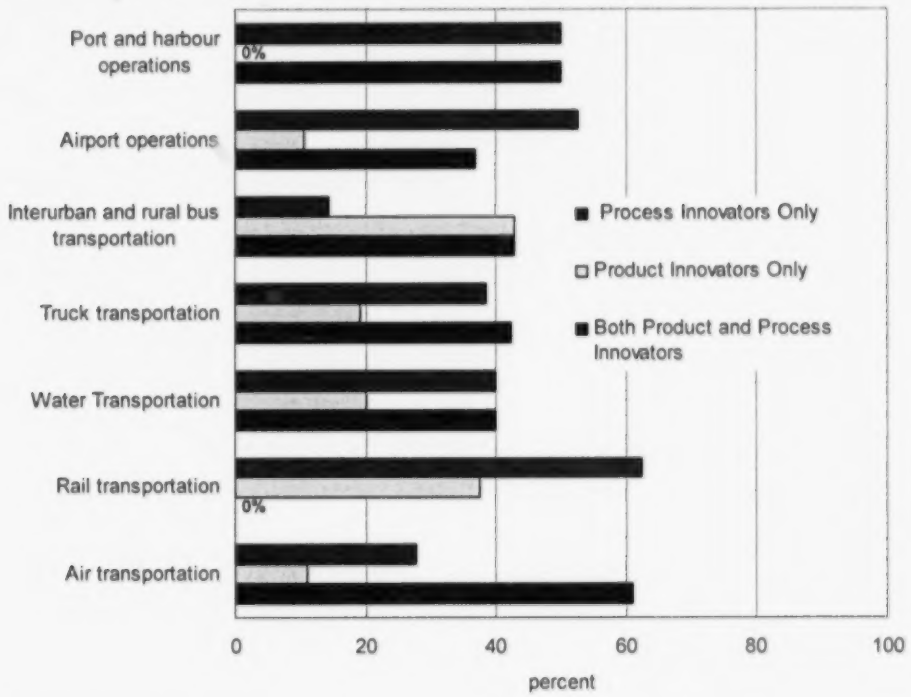
Figure 2
Percentage of innovative establishments engaged in product and process innovation, 2001 to 2003



Source: *Appendix II, table 2A*

When examined in terms of the three types of innovators (product only, process only or both product and process), variations emerged between the selected transportation industries with no clear patterns apparent (Figure 3). In "Air transportation" and "Truck transportation", the largest group of innovators were both product and process innovators. Process only innovators were most common among "Rail transportation and airport operations" establishments. "Water transportation" and "Port and harbour operations" establishments reported equal proportions of innovators that engaged in product and process innovation versus those that reported process only innovation. Lastly, in "Interurban and rural bus transportation", an equal proportion of establishments engaged in both product and process innovation as in product innovation only.

Figure 3
Percentage of product only, process only, and both product and process innovators amongst innovative establishments, 2001 to 2003



Source: *Appendix II, table 2A*

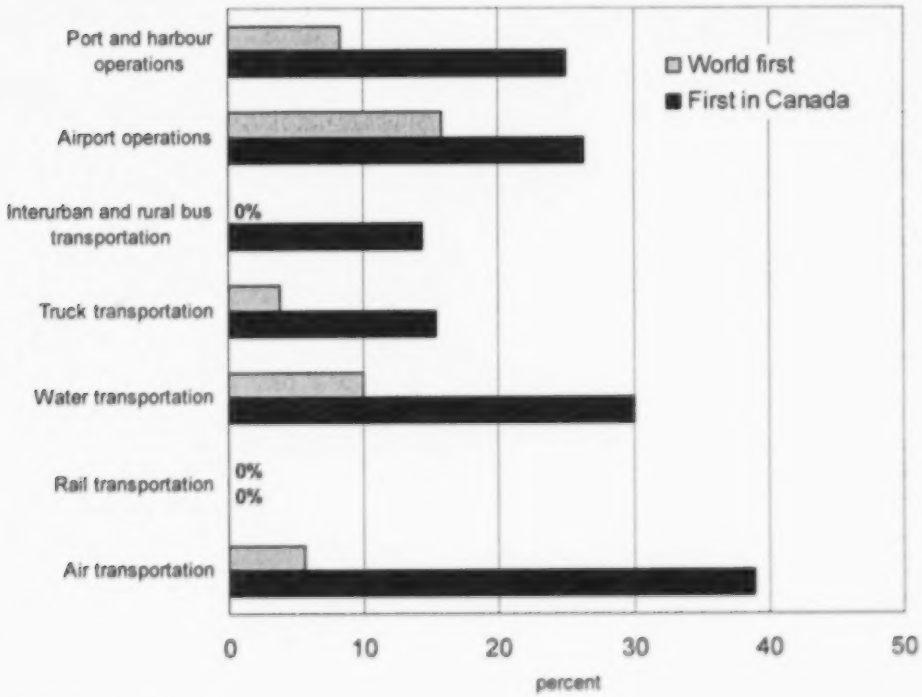
Novelty of innovation

Firms are innovative if they introduce products or processes which are new to the firm. There are however degrees of novelty; innovative products or processes may also be new to Canada or even new to the world.

The proportions of all innovative establishments in selected transportation industries reporting Canada-first innovations ranged from 0% in "Rail transportation" to 39% in "Air transportation".

Innovative "Airport operations" establishments reported the highest proportion of establishments with world-first innovations at 16% (Figure 4).

Figure 4
Novelty of new or significantly improved products (goods or services) and/or processes developed by innovative establishments in selected transportation industries, 2001 to 2003



Source: *Appendix II, table 3A*

2. How does innovation take place?

This section examines how innovation takes place. It looks at four aspects of innovation: sources of information, innovation activities, who develops innovations and the propensity to engage in cooperative and collaborative arrangements in order to develop innovation.

Sources of information needed for suggesting or contributing to the development of new or significantly improved products or processes may be located within the firm or outside it. The sources outside may arise from working relationships of the firm with its clients, suppliers, consultants, various laboratories and so on. Finally, the information may be generally available to the public.

Innovation can involve a broad range of activities, including engaging in R&D inside the firm, obtaining R&D performed outside the firm, acquisition of equipment and machinery as well as training and market introduction of innovative products.

Innovations can be developed mainly from within the establishment (including the firm the establishment is part of), they can be developed in co-operation with other firms or organizations or they can be developed mainly by other firms or organizations.

Establishments may choose to engage in cooperative or collaborative arrangements to innovate. These arrangements involve the active participation in joint projects between the establishment and other firm and organizations in order to develop new or significantly improved products or processes. Pure contracting out of work, where there is no active collaboration, is not regarded as co-operation.

Sources of information for innovation

Innovative establishments were asked to indicate which sources of information played an important role needed for suggesting or contributing to the development of innovations during the period 2001 to 2003 (Tables 2, 3 and 4). Sources of information varied by industry, and establishments availed themselves of a range of sources from each of the three categories.

Amongst the internal sources of information, management staff was the most frequently indicated source of information suggesting or contributing to the development of innovations. For six of the seven selected transportation industries this was the most frequently indicated source overall.

Table 2: Percentage of innovative establishments indicating that the internal source of information played an important[9] role suggesting or contributing to the development of innovations, 2001 to 2003

	Research and development staff	Marketing staff	Production staff	Management staff	Other business units in firm
Industry	%	%	%	%	%
Air transportation	11	45	45	72*	28
Rail transportation	13	50	50	75*	0
Water transportation	60	50	20	80	40
Truck transportation	27	42	73	92*	31
Interurban and rural bus transportation	0	0	14	100*	0
Airport operations	11	16	42	68*	11
Port and harbour operations	33	75	42	83*	0

Note: The overall most frequently indicated source for each industry is indicated with an asterisk, while the most frequently indicated source by category - internal, external and general - is highlighted.
Source: *Appendix II, table 4A*

9. Respondents were asked to indicate the importance of a series of 18 sources of information for innovation using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" was indicated by a response of 4 or 5. Respondents could also indicate 0, which indicated the source of information is not relevant.

Innovative establishments were asked to indicate the importance of eight external sources of information (the five most frequently selected are reported in Table 3 while all are reported in Table 5A in Appendix II). Amongst these sources of information suppliers of software, hardware, materials, or equipment and customers or clients were the most frequently indicated sources of information suggesting or contributing to the development of innovation during the period 2001 to 2003 (Table 3).

Table 3: Percentage of innovative establishments indicating that the external source of information played an important[10] role suggesting or contributing to the development of innovations, 2001 to 2003

Industry	Suppliers of software, hardware, materials, or equipment	Clients or customers	Consultancy firms	Competitors and other enterprises from same industry	Universities or other higher education institutes
	%	%	%	%	%
Air transportation	50	45	11	11	0
Rail transportation	50	63	38	25	0
Water transportation	90*	60	30	10	0
Truck transportation	31	85	15	31	12
Interurban and rural bus transportation	14	14	0	0	0
Airport operations	53	42	21	0	0
Port and harbour operations	67	83*	75	25	25

Note: The overall most frequently indicated source for each industry is indicated with an asterisk, while the most frequently indicated source by category - internal, external and general - is highlighted.
Source: *Appendix II, table 5A*

10. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

Lastly, amongst generally available sources of information, the Internet and professional conferences, meetings and journals were the most commonly indicated sources of generally available information on innovation (Table 4).

Table 4: Percentage of innovative establishments indicating that general sources of information played an important[11] role suggesting or contributing to the development of innovations, 2001 to 2003

Industry	Professional conferences, meetings, journals	Trade fairs and exhibitions	Trade associations	Internet
	%	%	%	%
Air transportation	39	22	33	72*
Rail transportation	63	25	25	13
Water transportation	0	20	10	60
Truck transportation	54	35	46	50
Interurban and rural bus transportation	0	0	14	57
Airport operations	53	26	37	47
Port and harbour operations	58	33	67	75

Note: The overall most frequently indicated source for each industry is indicated with an asterisk, while the most frequently indicated source by category - internal, external and general - is highlighted.
Source: *Appendix II, table 6A*

11. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

Innovation activities

Innovative establishments were asked to indicate their participation in a series of six innovation activities. Acquisition of equipment and machinery and training were the most frequently indicated activities associated with the introduction of innovative products or processes by all of the selected transportation industries (Table 5).

Table 5: Percentage of innovative establishments engaged in activities linked to product or process innovation, 2001 to 2003

	Internal research and development	External research and development	Acquisition of equipment and machinery	Acquisition of other external knowledge	Training	Market introduction of innovations
	%	%	%	%	%	%
Air transportation	50	61	83	50	89	67
Rail transportation	38	38	88	25	63	50
Water transportation	50	40	100	30	70	40
Truck transportation	50	23	85	27	62	31
Interurban and rural bus transportation	43	57	71	14	71	57
Airport operations	58	37	74	37	63	58
Port and harbour operations	58	58	83	67	83	50

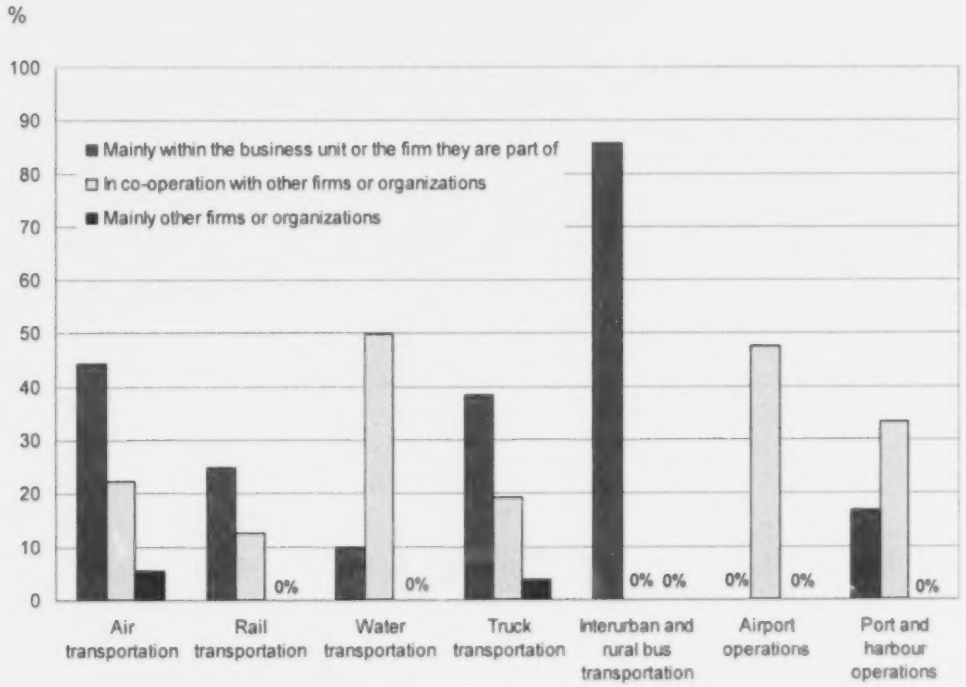
Note: The two activities indicated by the highest percentage of establishments are highlighted.
Source: *Appendix II, table 7A*

Where innovations are developed

Who developed product innovations varied markedly by industry but generally, product innovations were developed either mainly within the business unit or the firm they are part of, or in co-operation with other firms or organizations.

Establishments in "Air transportation", "Truck transportation" and "Interurban and rural bus transportation" were most likely to report product innovations were developed mainly within the business unit or the firm they are part of (Figure 5). By contrast, establishments in "Water transportation", "Airport operations" and "Port and harbour operations" most commonly indicated that product innovation was developed by the establishment in cooperation with other firms or organizations.

Figure 5
Percentage of all innovative establishments indicating who developed their product innovations that were introduced, 2001 to 2003

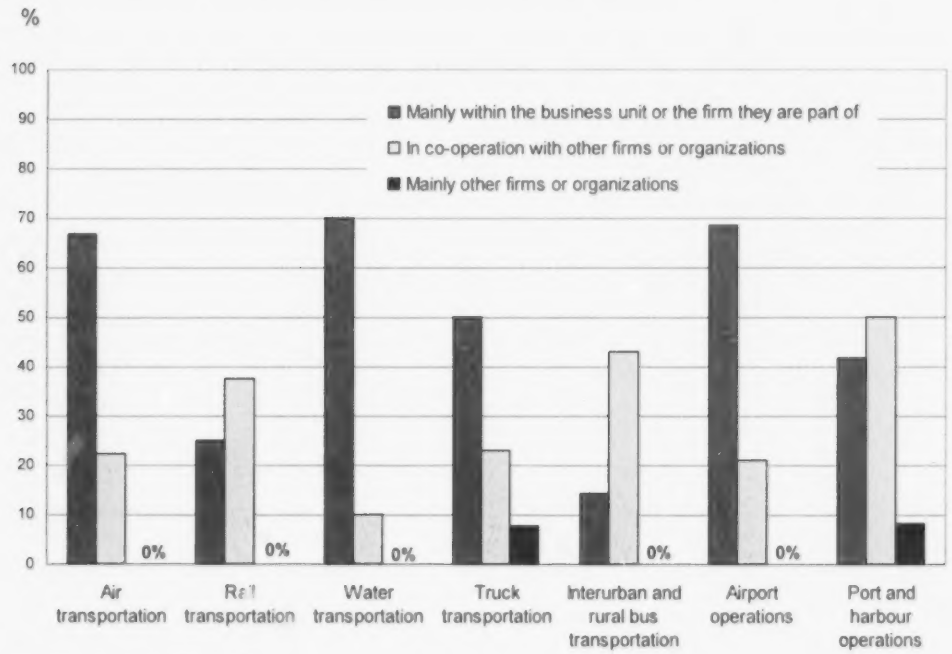


Source: *Appendix II, table 8A*

Who developed process innovations also varied by industry but again, process innovations were generally developed either mainly within the business unit or the firm they are part of, or in co-operation with other firms or organizations.

Establishments in "Air transportation", "Water transportation", "Truck transportation" and "Airport operations" were most likely to report process innovations were developed mainly within the business unit or the firm they are part of. By contrast, establishments in "Rail transportation" and "Interurban and rural bus transportation" most commonly indicated that process innovation was developed by the establishment in cooperation with other firms or organizations (Figure 6).

Figure 6
Percentage of all innovative establishments indicating who developed their process innovations that were introduced, 2001 to 2003

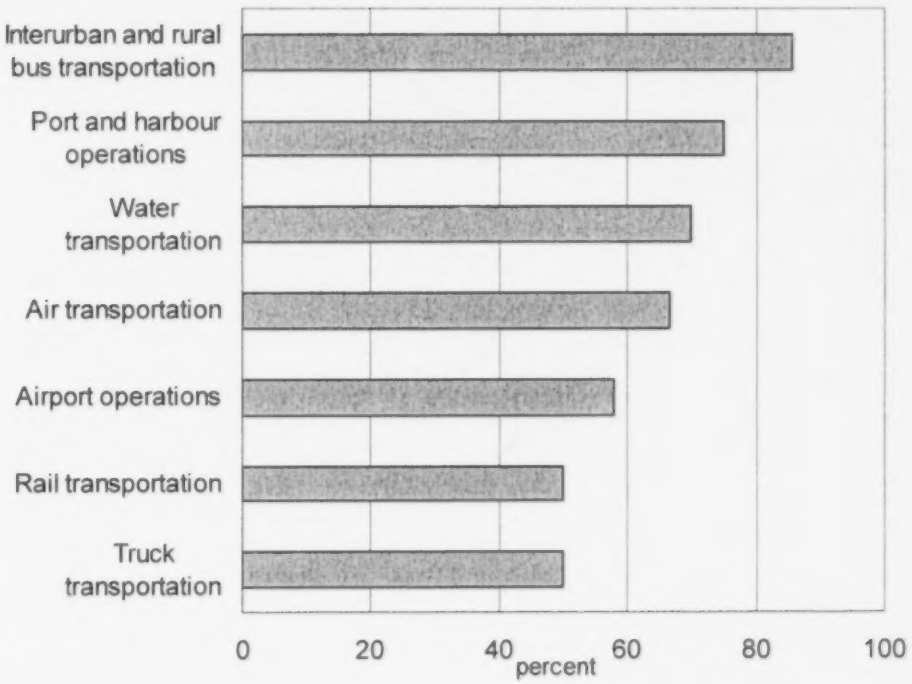


Source: *Appendix II, table 9A*

Innovation collaboration

In all selected transportation industries, at least half of all innovative establishments reported engaging in a cooperative or collaborative arrangement. "Interurban and rural bus transportation" establishments reported the highest proportion of innovative collaborators at 86% (Figure 7).

Figure 7
Percentage of innovative establishments involved in cooperative and collaborative arrangements, 2001 to 2003



Source: *Appendix II, table 10A*

While reasons for engaging in cooperative or collaborative arrangements varied by industry, innovative establishments in the two facilities operations industries ("Airport operations" and "Port and harbour operations") indicated the same top two objectives for collaboration; sharing costs and spreading risks (Table 6).

Table 6: Objectives of collaboration of innovative establishments[12] involved in cooperative and collaborative arrangements, 2001 to 2003

	Air transportation	Water transportation	Truck transportation	Airport operations	Port and harbour operations
	%	%	%	%	%
Sharing costs	58	14	54	100	89
Spreading risk	33	0	23	73	78
Accessing research and development	17	0	0	46	44
Prototype development	67	57	15	46	11
Scaling-up production process	25	43	39	0	22
Accessing critical expertise	67	43	54	64	67
Accessing new markets	42	14	46	36	78
Accessing new distribution channels	17	71	39	27	44

Note: The top two objectives for entering into cooperative or collaborative arrangements are highlighted for each industry.
Source: *Appendix II, table 11A*

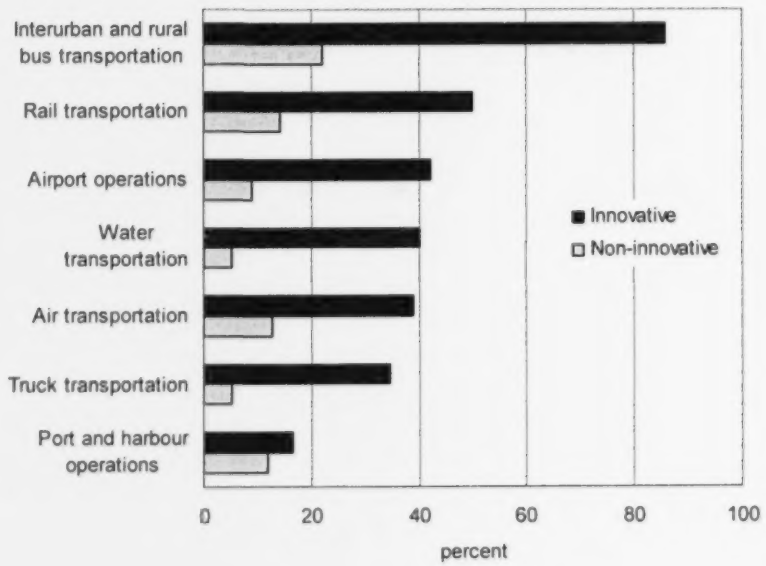
12. Note that reliable data were not available for "Rail transportation" and "Interurban and rural bus transportation" for reasons of reliability.

Not yet completed or abandoned innovation activities

Some establishments may attempt innovation but not complete the process of bringing the product to market or the process to the factory. The attempted innovation may be abandoned or not yet completed.

The percentages of innovative establishments that indicated not yet completed or abandoned innovations ranged widely by industry, from 17% of innovative establishments in "Port and harbour operations" to 86% of innovative establishments in "Interurban and rural bus transportation". By contrast, far fewer non-innovative establishments in each of the selected transportation industries indicated that they had attempted to undertake innovation projects (Figure 8).

Figure 8
Percentage of establishments with unsuccessful or not yet completed projects to develop or introduce new or significantly improved products or processes, 2001 to 2003



Source: *Appendix II, table 11A*

3. What are the obstacles to innovation and the support programs for innovation?

This section will examine the problems and obstacles faced by innovative establishments who engage in innovative activities. Engaging in innovation activities requires the allocation of resources, both human and financial, by the establishment or the larger enterprise to which the establishment belongs. Obstacles to innovation can include a lack of such resources and perceived risk with respect to feasibility or market success.

Federal and provincial governments provide a variety of support programs to promote innovation activities. These support programs are intended to help overcome some of the obstacles to innovation, such as the perceived risks of innovation, the difficulty in finding trained staff to undertake innovation activities and the costs involved in innovation activities.

Problems and obstacles to innovation

Innovative establishments were asked to indicate the importance of 13 problems and obstacles which slowed down or caused problems during the development of innovations during the period 2001 to 2003 (Tables 7, 8 and 9). Obstacles were grouped into three categories: economic, internal and other. Amongst the three categories of factors, economic factors were indicated by the highest percentage of innovative establishments as important problems and obstacles, with the exception of establishments in "Interurban and rural bus transportation".

The level of importance to perceived problems and obstacles to innovation varied considerably by industry.

Economic factors

The economic factors most frequently indicated as important obstacles to innovation were risks related to the feasibility of the project and the costs of innovation (Table 7).

Table 7: Percentage of establishments indicating economic factors were important[13] problems and obstacles that slowed down or caused problems when developing innovations, 2001 to 2003

	Risk related to the feasibility of innovative projects	Risk in terms of innovation's market success	Innovation costs too high	Lack of appropriate sources of finance
	%	%	%	%
Air transportation	17	17	22	44*
Rail transportation	38*	25	25	13
Water transportation	40	20	50*	50*
Truck transportation	35*	27	35*	23
Interurban and rural bus transportation	57	57	57	43
Airport operations	32	32	47*	37
Port and harbour operations	50*	42	50*	25

Note: The overall most frequently indicated obstacle or problem for each industry is indicated with an asterisk, while the most frequently indicated problem or obstacle by category - economic, internal and other - is highlighted.
Source: *Appendix II, table 12A*

13. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

Internal factors

The internal factor most frequently indicated as an important obstacle to innovation was the inability to devote staff on an on-going basis due to production requirements (Table 8). This was followed by lack of qualified personnel indicated by establishments in three of seven selected transportation industries and organizational rigidities within the enterprise, indicated by establishments in two of seven selected transportation industries. Only establishments in "Port and harbour operations" indicated lack of information on technology and lack of information on markets as the most frequently indicated obstacles to innovation.

Table 8: Percentage of establishments indicating internal factors were important[14] problems and obstacles that slowed down or caused problems when developing innovations, 2001 to 2003

	Organizational rigidities within the enterprise	Inability to devote staff on on-going basis due to production requirements	Lack of qualified personnel	Lack of information on technology	Lack of information on markets
	%	%	%	%	%
Air transportation	6	39	33	28	6
Rail transportation	38*	38*	25	0	0
Water transportation	30	0	30	0	0
Truck transportation	15	19	31	8	12
Interurban and rural bus transportation	43	86*	86*	0	0
Airport operations	0	47*	21	0	16
Port and harbour operations	8	17	8	17	17

Note: The overall most frequently indicated obstacle or problem for each industry is indicated with an asterisk, while the most frequently indicated problem or obstacle by category - economic, internal and other - is highlighted.

Source: *Appendix II, table 13A*

14. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

Other factors

The other factor most frequently indicated by most of the selected transportation industries as an important obstacle to innovation by each of the selected transportation industries was insufficient flexibility of regulations or standards, followed by a lack of customer responsiveness to new goods or services (Table 9).

Table 9: Percentage of establishments indicating other factors were important[15] problems and obstacles that slowed down or caused problems when developing innovations, 2001 to 2003

	Insufficient flexibility of regulations or standards	Lack of customer responsiveness to new goods or services	Lack of industry-wide standards	Lack of regulations in e-commerce as obstacle to exporting innovative products
	%	%	%	%
Air transportation	33	6	22	0
Rail transportation	25	13	0	0
Water transportation	40	50*	30	10
Truck transportation	35*	23	27	8
Interurban and rural bus transportation	29	57	0	43
Airport operations	37	0	5	0
Port and harbour operations	25	0	8	0

Note: The overall most frequently indicated obstacle or problem for each industry is indicated with an asterisk, while the most frequently indicated problem or obstacle by category - economic, internal and other - is highlighted.

Source: *Appendix II, table 14A*

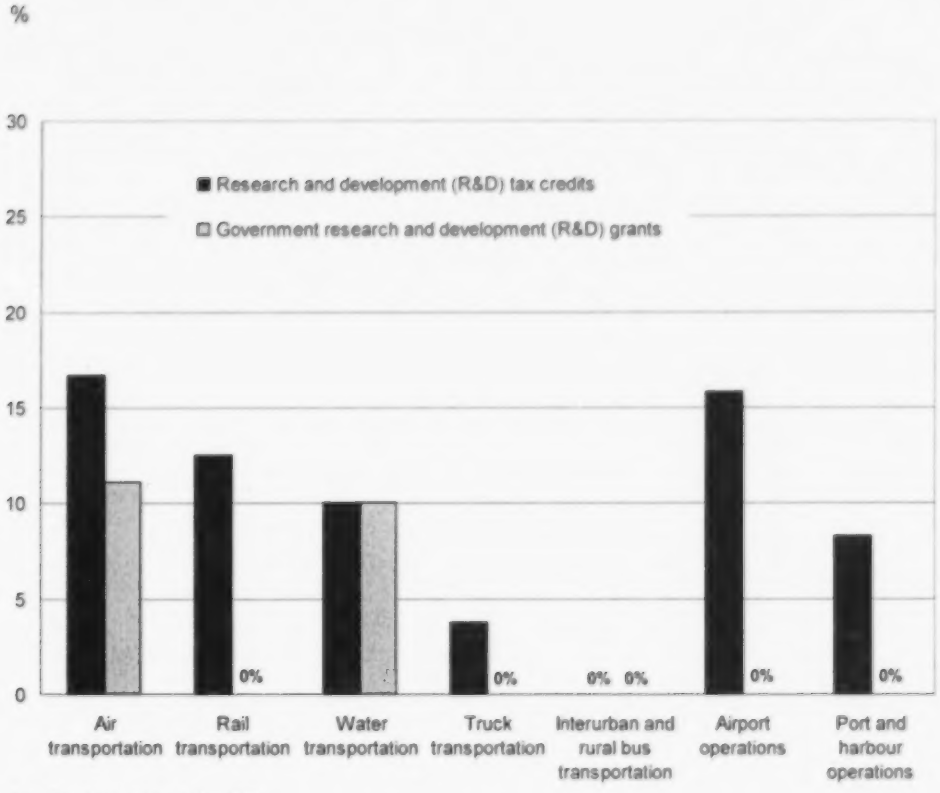
15. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

Government support programs

Government support programs generally fall into two categories: those that are designed to encourage R&D activities and other support programs.

Use of government R&D support programs, either R&D tax credits or R&D grants, were reported by less than 20% of all innovative establishments in each of the seven selected transportation industries (Figure 9).

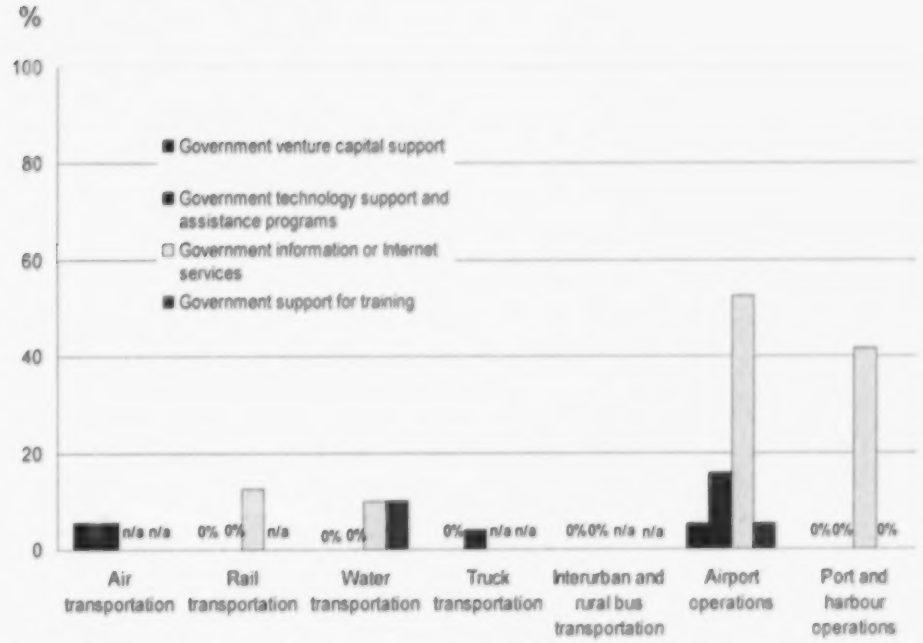
Figure 9
Percentage of innovative establishments indicating that they used government R&D programs, 2001 to 2003



Source: *Appendix II, table 15A*

Use of other types of government support programs was also fairly low, with the exception of the use of government information or internet services indicated by at least 40% of establishments in "Airport Operations" and "Port and Harbour Operations"(Figure 10).

Figure 10
Percentage of innovative establishments indicating that they used government support programs, 2001 to 2003



n/a: not available
Source: *Appendix II, table 15A*

4. What are the impacts of innovation?

This section will examine the impacts of innovation. Firms were asked to indicate the degree of agreement with a series of 10 possible impacts of innovation. Four of the 10 impacts were selected the most frequently by at least one of the seven selected transportation industries.

As with many aspects of innovation previously discussed, the impacts of innovation varied by industry (Table 10). The two most frequently indicated impacts were increased productivity and increased ability to keep up with competitors. These two impacts were most frequently selected in three of the seven industries, while the other two impacts, allowing business units to keep up with competitors and improved quality of products (goods or services) were most frequently selected by two industries.

Table 10: Percentage of innovative establishments that agreed[16] to the impact resulting from the development and introduction of innovations, 2001 to 2003

Industry	Increased the business unit's productivity		Increased the ability to adapt flexibly to different client demands		Allowed business unit to keep up with its competitors		Improved the quality of products (goods or services)	
	%	rank	%	rank	%	rank	%	rank
Air transportation	56	3	56	3	67	2	78	1
Rail transportation	63	1	50	3	63	1	25	7
Water transportation	100	1	70	2	40	8	60	5
Truck transportation	50	3	62	1	58	2	50	3
Interurban and rural bus transportation	0	8	86	1	43	2	43	2
Airport operations	63	2	58	4	26	6	74	1
Port and harbour operations	75	1	75	1	75	1	67	4

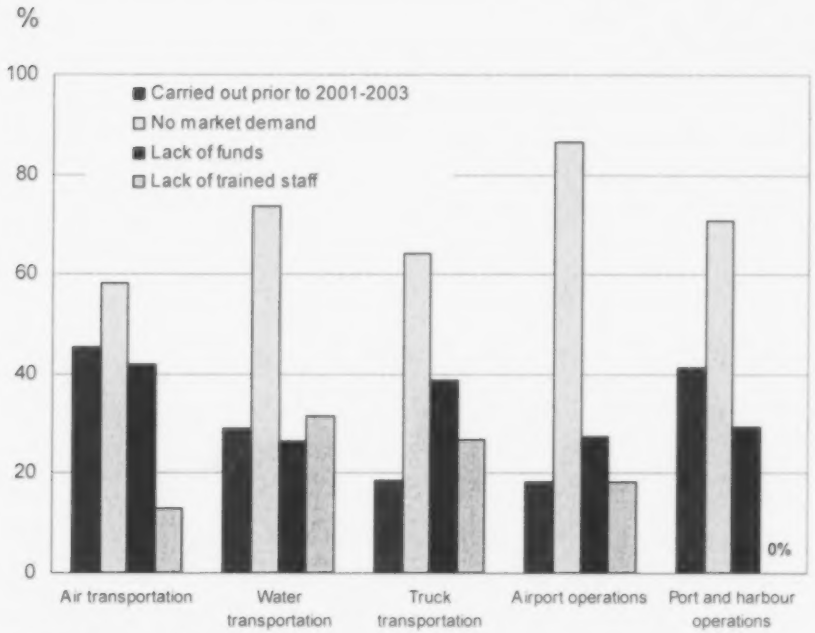
Note: The most frequently indicated impact is highlighted for each industry.
Source: *Appendix II, table 16A*

16. Establishments were asked whether or not they agreed with statements describing impacts of innovation. "Agree" indicates that they responded by selecting "4" or "5", while "Strongly agree" indicates that they selected "5" and "Not relevant" indicates that they selected "0".

5. Why do some establishments choose not to innovate?

Non-innovative establishments were asked why they chose not to innovate. Lack of market demand was the most frequently indicated reason for not developing innovative products for all selected transportation industries for which data were available[17] (Figure 11).

Figure 11
Percentage of establishments indicating reasons for not engaging in innovation during the period 2001-2003



Source: *Appendix II, table 17A*

17. No reliable data were available for non-innovative establishments in "Interurban and rural bus transportation" or "Rail transportation".

References

OECD/Eurostat (1997), *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual)*. Paris: OECD.

Statistics Canada (2002), *Survey of Innovation 1999, Statistical Tables, Manufacturing Industries*, Cat. No. 88F0006XIE2002016. Ottawa: Statistics Canada.

Statistics Canada (2003), *North American Industry Classification System: Canada 2002*. Cat. No. 12-501-XPE. Ottawa: Statistics Canada.

Statistics Canada (2005), *Survey of Innovation 2003: Statistical Tables for Selected Service Industries*, Catalogue No. 88-524-XCB. Ottawa: Statistics Canada.

Statistics Canada (2005), *Industrial Research and Development Intentions, 2004 Intentions*, Cat. No. 88-202-XIE. Ottawa: Statistics Canada.

Appendix I: Description of transportation industries

All establishments and enterprises in Canada are defined according to a classification system called the North American Industry Classification System (NAICS). This standard was revised in 2002, and it is this revised version which was used for the Survey of Innovation 2003.

NAICS 481 - Air Transportation - This subsector comprises establishments primarily engaged in for-hire, common-carrier transportation of people and/or goods using aircraft, such as airplanes and helicopters. Exclusions consist of establishments primarily engaged in scenic or sightseeing air services (48799, Scenic and Sightseeing Transportation, Other) or air courier services (49211, Couriers).

NAICS 482 – Rail Transportation - This subsector comprises establishments primarily engaged in operating railways. Establishments primarily engaged in the operation of long-haul or mainline railways, short-haul railways and passenger railways are included.

NAICS 483 – Water Transportation - This subsector comprises establishments primarily engaged in the water transportation of passengers and goods, using equipment designed for those purposes. Exclusions consist of establishments primarily engaged in same-day return sightseeing trips and cruises (48721, Scenic and Sightseeing Transportation, Water).

NAICS 484 – Truck Transportation - This subsector comprises establishments primarily engaged in the truck transportation of goods. These establishments may carry general freight or specialized freight. Specialized freight comprises goods that, because of size, weight, shape or other inherent characteristics, require specialized equipment for transportation. Establishments may operate locally, that is within a metropolitan area and its hinterland, or over long distances, that is between metropolitan areas.

NAICS 4852 – Interurban and rural bus transportation - This industry group comprises establishments primarily engaged in providing passenger transportation, principally outside a single municipality and its suburban areas, primarily by bus. These establishments operate over fixed routes and schedules, and charge a per-trip fee.

NAICS 48811 – Airport Operations - This industry comprises establishments primarily engaged in operating international, national and other civil airports. The activities involved in operating airports include renting hangar space, and providing air traffic control services, baggage handling, cargo handling and aircraft parking services. Public flying fields are included.

NAICS 48831 – Port and harbour operations - This industry comprises establishments primarily engaged in operating port and harbour facilities and services. Establishments engaged in the operation of lighthouses are included.

Appendix II: Detailed data tables

The reliability of the data is reported using the following symbol convention (Tables A and B) for quality indicator interpretation. This convention combines the effect of sampling and the imputation rate.

Quality Indicators

Table A: Coefficient of Variation

	Imputation Rate			
CV	**< 15%**	**≥ 15% and < 35%**	**≥ 35% and < 50%**	**≥ 50%**
≤ 5.0%	A	B	E	F
> 5.0% and ≤ 15.0%	B	E	F	F
> 15.0% and ≤ 30.0%	E	F	F	F
> 30.0%	F	F	F	F

Table B: Standard Error

	Imputation Rate			
Standard Error	**< 15%**	**≥ 15% and < 35%**	**≥ 35% and < 50%**	**≥ 50%**
≤2.5%	A	B	E	F
>2.5% and ≤7.5%	B	E	F	F
>7.5 and ≤15.0%	E	F	F	F
>15.0%	F	F	F	F

Estimates with a quality indicator of A are very reliable.
Estimates with a quality indicator of B are reliable.
Estimates with a quality indicator of E are to be used with caution.
Estimates with a quality indicator of F have very poor reliability and have been suppressed.

Measures of importance and agreement

For Tables 4, 5, 6, 13 and 14 establishments were asked to indicate the importance of various factors in question, be it sources of information, problems and obstacles, etc. Respondents were asked to indicate the importance using a scale of 1 to 5, where 1 is low importance and 5 is high importance. "Important" in the descriptive text portion of this document indicates a response of "4" or "5". In the tables that follow, "High" indicates a response of "5" and "Moderately high" indicates a response of "4". Respondents could also indicate "0", which indicated the factor was not relevant.

For Table 16, establishments were asked for their degree of agreement with statements describing impacts of innovation. "Agree" indicates that they responded by selecting "4" or "5", while "Strongly agree" indicates that they selected "5" and "Not relevant" indicates that they selected "0".

Statistical Unit

The questionnaire was directed to establishments. "The establishment is the level at which the accounting data required to measure production is available (principal inputs, revenues, salaries and wages).The establishment, as a statistical unit, is defined as the most

homogeneous unit of production for which the business maintains accounting records from which it is possible to assemble all the data elements required to compile the full structure of the gross value of production (total sales or shipments, and inventories), the cost of materials and services, and labour and capital used in production."[18] In the questionnaire, establishments were referred to as "business units" as this terminology was found to be more familiar to respondents completing the survey. Establishments were also asked whether or not they belonged to larger firms, which corresponds to the statistical concept of the enterprise.

Note: A complete set of tables, comprising over one thousand tables presenting the results of the Survey of Innovation, 2003, for Canada and all provinces and territories is available on a CD-ROM entitled *Survey of Innovation 2003: Statistical Tables for Selected Service Industries*, catalogue number 88-524-XCB.

18. Source: http://www.statcan.ca/english/concepts/stat-unit-def.htm

Table 1A: Percentage of innovative establishments, 2001 to 2003

	Innovators	
	%	Reliability
Air transportation	36.7	B
Rail transportation	53.3	B
Water transportation	20.8	B
Truck transportation	25.7	B
Interurban and rural bus transportation	43.8	E
Airport operations	46.3	B
Port and harbour operations	41.4	A

Table 2A: Percentage of types of innovative establishments, 2001 to 2003

	Innovators		Product Innovators		Process Innovators	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	100.0	A	72.2	E	88.9	B
Rail transportation	100.0	A	37.5	E	62.5	E
Water transportation	100.0	A	60.0	E	80.0	E
Truck transportation	100.0	A	61.5	E	80.8	B
Interurban and rural bus transportation	100.0	A	85.7	E	57.1	E
Airport operations	100.0	A	47.4	B	89.5	B
Port and harbour operations	100.0	A	50.0	B	100.0	A

Table 2A (con't): Percentage of types of innovative establishments, 2001 to 2003

	Both Product and Process Innovators		Product Innovators Only		Process Innovators Only	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	61.1	E	11.1	B	27.8	E
Rail transportation	0.0	A	37.5	E	62.5	E
Water transportation	40.0	E	20.0	E	40.0	E
Truck transportation	42.3	E	19.2	B	38.5	E
Interurban and rural bus transportation	42.9	E	42.9	E	14.3	E
Airport operations	36.8	B	10.5	B	52.6	B
Port and harbour operations	50.0	B	0.0	A	50.0	B

Table 3A - Novelty of new or significantly improved products (goods or services) and/or processes, developed by innovative establishments, 2001 to 2003

	First in Canada		World first	
	%	Reliability	%	Reliability
Air transportation	38.9	E	5.6	B
Rail transportation	0.0	A	0.0	A
Water transportation	30.0	E	10.0	B
Truck transportation	15.4	B	3.8	B
Interurban and rural bus transportation	14.3	E	0.0	A
Airport operations	26.3	B	15.8	B
Port and harbour operations	25.0	A	8.3	A

Table 4A: Percentage of innovative establishments using internal sources of information needed for suggesting or contributing to the development of innovation, 2001 to 2003

		Importance					
		Moderately high		High		Not relevant	
		%	Reliability	%	Reliability	%	Reliability
Air transportation	Research and development staff	0.0	A	11.1	B	50.0	E
	Marketing staff	38.9	E	5.6	B	16.7	B
	Production staff	27.8	E	16.7	B	22.2	B
	Management staff	38.9	E	33.3	E	5.6	B
	Other business units in firm	22.2	B	5.6	B	27.8	E
Rail transportation	Research and development staff	12.5	B	0.0	A	50.0	E
	Marketing staff	25.0	E	25.0	E	12.5	B
	Production staff	50.0	E	0.0	A	12.5	B
	Management staff	0.0	A	75.0	E	0.0	A
	Other business units in firm	0.0	A	0.0	A	0.0	A
Water transportation	Research and development staff	10.0	B	50.0	E	30.0	E
	Marketing staff	30.0	E	20.0	E	10.0	B
	Production staff	0.0	A	20.0	E	10.0	B
	Management staff	30.0	E	50.0	E	0.0	A
	Other business units in firm	10.0	B	30.0	E	40.0	E
Truck transportation	Research and development staff	19.2	B	7.7	B	11.5	B
	Marketing staff	30.8	E	11.5	B	11.5	B
	Production staff	50.0	E	23.1	E	11.5	B
	Management staff	53.8	E	38.5	E	0.0	A
	Other business units in firm	26.9	E	3.8	B	53.8	E
Interurban and rural bus transportation	Research and development staff	0.0	A	0.0	A	42.9	E
	Marketing staff	0.0	A	0.0	A	0.0	A
	Production staff	14.3	E	0.0	A	85.7	E
	Management staff	100.0	A	0.0	A	0.0	A
	Other business units in firm	0.0	A	0.0	A	28.6	E
Airport operations	Research and development staff	0.0	A	10.5	B	73.7	B
	Marketing staff	15.8	B	0.0	A	31.6	B
	Production staff	42.1	B	0.0	A	10.5	B
	Management staff	42.1	B	26.3	B	21.1	B
	Other business units in firm	10.5	B	0.0	A	63.2	B
Port and harbour operations	Research and development staff	33.3	A	0.0	A	41.7	B
	Marketing staff	33.3	A	41.7	B	8.3	A
	Production staff	33.3	A	8.3	A	41.7	B
	Management staff	66.7	A	16.7	A	0.0	A
	Other business units in firm	0.0	A	0.0	A	75.0	A

Table 5A: Percentage of innovative establishments using external sources of information needed for suggesting or contributing to the development of innovation, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Suppliers of software, hardware, materials, or equipment	11.1	B	38.9	E	16.7	B
Clients or customers	16.7	B	27.8	E	11.1	B
Consultancy firms	11.1	B	0.0	A	44.4	E
Competitors and other enterprises from same industry	11.1	B	0.0	A	11.1	B
Universities or other higher education institutes	0.0	A	0.0	A	66.7	E
Federal government research laboratories	0.0	A	0.0	A	66.7	E
Provincial/territorial government research laboratories	0.0	A	0.0	A	66.7	E
Private non-profit research laboratories	0.0	A	0.0	A	66.7	E
Rail transportation						
Suppliers of software, hardware, materials, or equipment	50.0	E	0.0	A	0.0	A
Clients or customers	37.5	E	25.0	E	0.0	A
Consultancy firms	37.5	E	0.0	A	37.5	E
Competitors and other enterprises from same industry	0.0	A	25.0	E	0.0	A
Universities or other higher education institutes	0.0	A	0.0	A	50.0	E
Federal government research laboratories	0.0	A	0.0	A	50.0	E
Provincial/territorial government research laboratories	0.0	A	0.0	A	50.0	E
Private non-profit research laboratories	0.0	A	0.0	A	50.0	E
Water transportation						
Suppliers of software, hardware, materials, or equipment	30.0	E	60.0	E	0.0	A
Clients or customers	20.0	E	40.0	E	20.0	E
Consultancy firms	10.0	B	20.0	E	20.0	E
Competitors and other enterprises from same industry	10.0	B	0.0	A	30.0	E
Universities or other higher education institutes	0.0	A	0.0	A	60.0	E
Federal government research laboratories	0.0	A	0.0	A	60.0	E
Provincial/territorial government research laboratories	0.0	A	0.0	A	60.0	E
Private non-profit research laboratories	0.0	A	0.0	A	60.0	E
Truck transportation						
Suppliers of software, hardware, materials, or equipment	15.4	B	15.4	B	7.7	B
Clients or customers	30.8	E	53.8	E	0.0	A
Consultancy firms	7.7	B	7.7	B	19.2	B
Competitors and other enterprises from same industry	19.2	B	11.5	B	7.7	B
Universities or other higher education institutes	11.5	B	0.0	A	38.5	E
Federal government research laboratories	7.7	B	0.0	A	46.2	E
Provincial/territorial government research laboratories	7.7	B	0.0	A	46.2	E
Private non-profit research laboratories	7.7	B	0.0	A	46.2	E

Table 5A (con't): Percentage of innovative establishments using external sources of information needed for suggesting or contributing to the development of innovation, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Interurban and rural bus transportation						
Suppliers of software, hardware, materials, or equipment	14.3	E	0.0	A	0.0	A
Clients or customers	14.3	E	0.0	A	0.0	A
Consultancy firms	0.0	A	0.0	A	57.1	E
Competitors and other enterprises from same industry	0.0	A	0.0	A	14.3	E
Universities or other higher education institutes	0.0	A	0.0	A	100.0	A
Federal government research laboratories	0.0	A	0.0	A	100.0	A
Provincial/territorial government research laboratories	0.0	A	0.0	A	100.0	A
Private non-profit research laboratories	0.0	A	0.0	A	100.0	A
Airport operations						
Suppliers of software, hardware, materials, or equipment	42.1	B	10.5	B	15.8	B
Clients or customers	36.8	B	5.3	B	10.5	B
Consultancy firms	21.1	B	0.0	A	15.8	B
Competitors and other enterprises from same industry	0.0	A	0.0	A	31.6	B
Universities or other higher education institutes	0.0	A	0.0	A	42.1	B
Federal government research laboratories	0.0	A	0.0	A	63.2	B
Provincial/territorial government research laboratories	0.0	A	0.0	A	63.2	B
Private non-profit research laboratories	0.0	A	0.0	A	63.2	B
Port and harbour operations						
Suppliers of software, hardware, materials, or equipment	41.7	B	25.0	A	0.0	A
Clients or customers	33.3	A	50.0	B	0.0	A
Consultancy firms	41.7	B	33.3	A	16.7	A
Competitors and other enterprises from same industry	16.7	A	8.3	A	8.3	A
Universities or other higher education institutes	25.0	A	0.0	A	50.0	B
Federal government research laboratories	0.0	A	0.0	A	50.0	B
Provincial/territorial government research laboratories	0.0	A	0.0	A	50.0	B
Private non-profit research laboratories	0.0	A	0.0	A	50.0	B

Table 6A: Percentage of innovative establishments using general sources of information needed for suggesting or contributing to the development of innovation, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Professional conferences, meetings, journals	27.8	E	11.1	B	16.7	B
Trade fairs and exhibitions	16.7	B	5.6	B	5.6	B
Trade associations	27.8	E	5.6	B	11.1	B
Internet	44.4	E	27.8	E	5.6	B
Rail transportation						
Professional conferences, meetings, journals	62.5	E	0.0	A	25.0	E
Trade fairs and exhibitions	25.0	E	0.0	A	25.0	E
Trade associations	12.5	B	12.5	B	25.0	E
Internet	12.5	B	0.0	A	25.0	E
Water transportation						
Professional conferences, meetings, journals	0.0	A	0.0	A	10.0	B
Trade fairs and exhibitions	20.0	E	0.0	A	10.0	B
Trade associations	10.0	B	0.0	A	10.0	B
Internet	10.0	B	50.0	E	10.0	B
Truck transportation						
Professional conferences, meetings, journals	38.5	E	15.4	B	7.7	B
Trade fairs and exhibitions	34.6	E	0.0	A	23.1	E
Trade associations	34.6	E	11.5	B	15.4	B
Internet	42.3	E	7.7	B	7.7	B
Interurban and rural bus transportation						
Professional conferences, meetings, journals	0.0	A	0.0	A	0.0	A
Trade fairs and exhibitions	0.0	A	0.0	A	0.0	A
Trade associations	14.3	E	0.0	A	0.0	A
Internet	57.1	E	0.0	A	0.0	A
Airport operations						
Professional conferences, meetings, journals	47.4	B	5.3	B	10.5	B
Trade fairs and exhibitions	26.3	B	0.0	A	21.1	B
Trade associations	36.8	B	0.0	A	10.5	B
Internet	31.6	B	15.8	B	10.5	B
Port and harbour operations						
Professional conferences, meetings, journals	25.0	A	33.3	A	0.0	A
Trade fairs and exhibitions	16.7	A	16.7	A	0.0	A
Trade associations	66.7	A	0.0	A	0.0	A
Internet	58.3	B	16.7	A	0.0	A

Table 7A: Percentage of innovative establishments engaged in activities linked to product or process innovation, 2001 to 2003

	Internal research and development		External research and development		Acquisition of equipment and machinery	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	50.0	E	61.1	E	83.3	B
Rail transportation	37.5	E	37.5	E	87.5	B
Water transportation	50.0	E	40.0	E	100.0	A
Truck transportation	50.0	E	23.1	E	84.6	B
Interurban and rural bus transportation	42.9	E	57.1	E	71.4	E
Airport operations	57.9	B	36.8	B	73.7	B
Port and harbour operations	58.3	B	58.3	B	83.3	A

Table 7A (con't): Percentage of innovative establishments engaged in activities linked to product or process innovation, 2001 to 2003

	Acquisition of other external knowledge		Training		Market introduction of innovations	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	50.0	E	88.9	B	66.7	E
Rail transportation	25.0	E	62.5	E	50.0	E
Water transportation	30.0	E	70.0	E	40.0	E
Truck transportation	26.9	E	61.5	E	30.8	E
Interurban and rural bus transportation	14.3	E	71.4	E	57.1	E
Airport operations	36.8	B	63.2	B	57.9	B
Port and harbour operations	66.7	A	83.3	A	50.0	B

Table 8A: Percentage of innovative establishments indicating where their product (goods or services) innovations that were introduced during the period 2001 to 2003 were developed

	Mainly within the business unit or the firm they are part of		In co-operation with other firms or organizations		Mainly other firms or organizations	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	44.4	E	22.2	B	5.6	B
Rail transportation	25.0	E	12.5	B	0.0	A
Water transportation	10.0	B	50.0	E	0.0	A
Truck transportation	38.5	E	19.2	B	3.8	B
Interurban and rural bus transportation	85.7	E	0.0	A	0.0	A
Airport operations	0.0	A	47.4	B	0.0	A
Port and harbour operations	16.7	A	33.3	A	0.0	A

Table 9A: Percentage of innovative establishments indicating where their process innovations that were introduced during the period 2001 to 2003 were developed

	Mainly within the business unit or the firm they are part of		In co-operation with other firms or organizations		Mainly other firms or organizations	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	66.7	E	22.2	B	0.0	A
Rail transportation	25.0	E	37.5	E	0.0	A
Water Transportation	70.0	E	10.0	B	0.0	A
Truck transportation	50.0	E	23.1	E	7.7	B
Interurban and rural bus transportation	14.3	E	42.9	E	0.0	A
Airport operations	68.4	B	21.1	B	0.0	A
Port and harbour operations	41.7	B	50.0	B	8.3	A

Table 10A: Percentage of innovative establishments involved in cooperative and collaborative arrangements, 2001 to 2003

	%	Reliability
Air transportation	66.7	E
Rail transportation	50.0	E
Water transportation	70.0	E
Truck transportation	50.0	E
Interurban and rural bus transportation	85.7	E
Airport operations	57.9	B
Port and harbour operations	75.0	A

Table 11A: Percentage of innovative establishments in cooperative or collaborative arrangements indicating reasons for involvement in cooperative and collaborative arrangements, 2001 to 2003

	Sharing costs		Spreading risk		Accessing research and development		Prototype development	
	%	Reliability	%	Reliability	%	Reliability	%	Reliability
Air transportation	58.3	E	33.0	E	16.7	E	66.7	E
Rail transportation	x	E	x	A	x	A	x	A
Water transportation	14.3	E	0.0	A	0.0	A	57.1	E
Truck transportation	53.8	E	23.0	E	0.0	A	15.4	E
Interurban and rural bus transportation	x	E	x	E	x	A	x	E
Airport operations	100	A	73.0	B	45.5	E	45.5	E
Port and harbour operations	88.9	A	78.0	B	44.4	B	11.1	A

Table 11A (con't): Percentage of innovative establishments in cooperative or collaborative arrangements indicating reasons for involvement in cooperative and collaborative arrangements, 2001 to 2003

	Scaling-up production process		Accessing critical expertise		Accessing new markets		Accessing new distribution channels	
	%	Reliability	%	Reliability	%	Reliability	%	Reliability
Air transportation	25.0	E	66.7	E	41.7	E	16.7	E
Rail transportation	x	E	x	A	x	A	x	A
Water transportation	42.9	E	42.9	E	14.3	E	71.4	E
Truck transportation	38.5	E	53.8	E	46.2	E	38.5	E
Interurban and rural bus transportation	x	E	x	E	x	E	x	E
Airport operations	0.0	A	63.6	E	36.4	E	27.3	B
Port and harbour operations	22.2	B	66.7	B	77.8	B	44.4	B

Table 12A: Percentage of establishments with unsuccessful or not yet completed projects to develop or introduce new or significantly improved products (goods or services) or processes, 2001 to 2003

	All		Innovators		Non-innovators	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	22.4	B	38.9	E	12.9	B
Rail transportation	33.3	B	50.0	E	14.3	B
Water transportation	12.5	B	40.0	E	5.3	A
Truck transportation	12.9	B	34.6	E	5.3	A
Interurban and rural bus transportation	50.0	E	85.7	E	22.2	E
Airport operations	24.4	B	42.1	B	9.1	B
Port and harbour operations	13.8	A	16.7	A	11.8	A

Table 13A: Percentage of innovative establishments with economic problems and obstacles that slowed down or caused problems when developing new or significantly improved products (goods or services) or processes, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Risk related to the feasibility of innovative projects	11.1	B	5.6	B	22.2	B
Risk in terms of innovation's market success	0.0	A	16.7	B	22.2	B
Innovation costs too high	0.0	A	22.2	B	27.8	E
Lack of appropriate sources of finance	0.0	A	44.4	E	27.8	E
Rail transportation						
Risk related to the feasibility of innovative projects	37.5	E	0.0	A	0.0	A
Risk in terms of innovation's market success	25.0	E	0.0	A	25.0	E
Innovation costs too high	25.0	E	0.0	A	25.0	E
Lack of appropriate sources of finance	0.0	A	12.5	B	50.0	E
Water transportation						
Risk related to the feasibility of innovative projects	30.0	E	10.0	B	20.0	E
Risk in terms of innovation's market success	0.0	A	20.0	E	20.0	E
Innovation costs too high	0.0	A	50.0	E	20.0	E
Lack of appropriate sources of finance	30.0	E	20.0	E	20.0	E
Truck transportation						
Risk related to the feasibility of innovative projects	34.6	E	0.0	A	26.9	E
Risk in terms of innovation's market success	26.9	E	0.0	A	34.6	E
Innovation costs too high	30.8	E	3.8	B	38.5	E
Lack of appropriate sources of finance	19.2	B	3.8	B	34.6	E
Interurban and rural bus transportation						
Risk related to the feasibility of innovative projects	42.9	E	14.3	E	0.0	A
Risk in terms of innovation's market success	42.9	E	14.3	E	0.0	A
Innovation costs too high	42.9	E	14.3	E	0.0	A
Lack of appropriate sources of finance	0.0	A	42.9	E	0.0	A
Airport operations						
Risk related to the feasibility of innovative projects	5.3	B	26.3	B	36.8	B
Risk in terms of innovation's market success	10.5	B	21.1	B	52.6	B
Innovation costs too high	36.8	B	10.5	B	26.3	B
Lack of appropriate sources of finance	0.0	A	36.8	B	42.1	B
Port and harbour operations						
Risk related to the feasibility of innovative projects	41.7	B	8.3	A	8.3	A
Risk in terms of innovation's market success	33.3	A	8.3	A	8.3	A
Innovation costs too high	41.7	B	8.3	A	8.3	A
Lack of appropriate sources of finance	25.0	A	0.0	A	8.3	A

Table 13A (con't): Percentage of innovative establishments with internal problems and obstacles that slowed down or caused problems when developing new or significantly improved products (goods or services) or processes, 2001 to 2003

	Importance				Not relevant	
	Moderately high		High			
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Organizational rigidities within the enterprise	5.6	B	0.0	A	22.2	B
Inability to devote staff on on-going basis due to production requirements	22.2	B	16.7	B	16.7	B
Lack of qualified personnel	27.8	E	5.6	B	16.7	B
Lack of information on technology	27.8	E	0.0	A	27.8	E
Lack of information on markets	5.6	B	0.0	A	22.2	B
Rail transportation						
Organizational rigidities within the enterprise	25.0	E	12.5	B	12.5	B
Inability to devote staff on on-going basis due to production requirements	37.5	E	0.0	A	12.5	B
Lack of qualified personnel	25.0	E	0.0	A	12.5	B
Lack of information on technology	0.0	A	0.0	A	50.0	E
Lack of information on markets	0.0	A	0.0	A	62.5	E
Water transportation						
Organizational rigidities within the enterprise	30.0	E	0.0	A	20.0	E
Inability to devote staff on on-going basis due to production requirements	0.0	A	0.0	A	20.0	E
Lack of qualified personnel	30.0	E	0.0	A	20.0	E
Lack of information on technology	0.0	A	0.0	A	20.0	E
Lack of information on markets	0.0	A	0.0	A	20.0	E
Truck transportation						
Organizational rigidities within the enterprise	11.5	B	3.8	B	50.0	E
Inability to devote staff on on-going basis due to production requirements	19.2	B	0.0	A	46.2	E
Lack of qualified personnel	30.8	E	0.0	A	26.9	E
Lack of information on technology	7.7	B	0.0	A	38.5	E
Lack of information on markets	11.5	B	0.0	A	53.8	E
Interurban and rural bus transportation						
Organizational rigidities within the enterprise	0.0	A	42.9	E	14.3	E
Inability to devote staff on on-going basis due to production requirements	28.6	E	57.1	E	0.0	A
Lack of qualified personnel	85.7	E	0.0	A	0.0	A
Lack of information on technology	0.0	A	0.0	A	0.0	A
Lack of information on markets	0.0	A	0.0	A	14.3	E

Table 13A (con't): Percentage of innovative establishments with internal problems and obstacles that slowed down or caused problems when developing new or significantly improved products (goods or services) or processes, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Airport operations						
Organizational rigidities within the enterprise	0.0	A	0.0	A	15.8	B
Inability to devote staff on on-going basis due to production requirements	31.6	B	15.8	B	10.5	B
Lack of qualified personnel	5.3	B	15.8	B	10.5	B
Lack of information on technology	0.0	A	0.0	A	21.1	B
Lack of information on markets	15.8	B	0.0	A	36.8	B
Port and harbour operations						
Organizational rigidities within the enterprise	8.3	A	0.0	A	8.3	A
Inability to devote staff on on-going basis due to production requirements	16.7	A	0.0	A	8.3	A
Lack of qualified personnel	8.3	A	0.0	A	8.3	A
Lack of information on technology	16.7	A	0.0	A	16.7	A
Lack of information on markets	16.7	A	0.0	A	25.0	A

Table 14A: Percentage of innovative establishments with other problems and obstacles that slowed down or caused problems when developing new or significantly improved products (goods or services) or processes, 2001 to 2003

	Importance				Not relevant	
	Moderately high		High			
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Insufficient flexibility of regulations or standards	0.0	A	33.3	E	22.2	B
Lack of customer responsiveness to new goods or services	5.6	B	0.0	A	11.1	B
Lack of industry-wide standards	11.1	B	11.1	B	11.1	B
Lack of regulations in e-commerce as obstacle to exporting innovative products	0.0	A	0.0	A	55.6	E
Rail transportation						
Insufficient flexibility of regulations or standards	25.0	E	0.0	A	62.5	E
Lack of customer responsiveness to new goods or services	0.0	A	12.5	B	37.5	E
Lack of industry-wide standards	0.0	A	0.0	A	62.5	E
Lack of regulations in e-commerce as obstacle to exporting innovative products	0.0	A	0.0	A	75.0	E
Water transportation						
Insufficient flexibility of regulations or standards	40.0	E	0.0	A	30.0	E
Lack of customer responsiveness to new goods or services	50.0	E	0.0	A	30.0	E
Lack of industry-wide standards	0.0	A	30.0	E	40.0	E
Lack of regulations in e-commerce as obstacle to exporting innovative products	0.0	A	10.0	B	70.0	E
Truck transportation						
Insufficient flexibility of regulations or standards	34.6	E	0.0	A	46.2	E
Lack of customer responsiveness to new goods or services	11.5	B	11.5	B	26.9	E
Lack of industry-wide standards	11.5	B	15.4	B	19.2	B
Lack of regulations in e-commerce as obstacle to exporting innovative products	7.7	B	0.0	A	50.0	E
Interurban and rural bus transportation						
Insufficient flexibility of regulations or standards	28.6	E	0.0	A	14.3	E
Lack of customer responsiveness to new goods or services	42.9	E	14.3	E	0.0	A
Lack of industry-wide standards	0.0	A	0.0	A	0.0	A
Lack of regulations in e-commerce as obstacle to exporting innovative products	42.9	E	0.0	A	42.9	E
Airport operations						
Insufficient flexibility of regulations or standards	31.6	B	5.3	B	15.8	B
Lack of customer responsiveness to new goods or services	0.0	A	0.0	A	26.3	B
Lack of industry-wide standards	5.3	B	0.0	A	31.6	B
Lack of regulations in e-commerce as obstacle to exporting innovative products	0.0	A	0.0	A	89.5	B

Table 14A (con't): Percentage of innovative establishments with other problems and obstacles that slowed down or caused problems when developing new or significantly improved products (goods or services) or processes, 2001 to 2003

	Importance					
	Moderately high		High		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Port and harbour operations						
Insufficient flexibility of regulations or standards	8.3	A	16.7	A	25.0	A
Lack of customer responsiveness to new goods or services	0.0	A	0.0	A	33.3	A
Lack of industry-wide standards	0.0	A	8.3	A	41.7	B
Lack of regulations in e-commerce as obstacle to exporting innovative products	0.0	A	0.0	A	41.7	B

Table 15A: Percentage of innovative establishments that used programs sponsored by the federal or provincial/territorial governments, 2001 to 2003

	Government programs					
	Federal government		Provincial/ territorial government		Did not use government program	
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Research and development (R&D) tax credits	6.1	B	4.1	B	93.9	B
Government research and development (R&D) grants	4.1	B	0.0	B	95.9	B
Government venture capital support	4.1	B	2.0	B	93.9	B
Government technology support and assistance programs	6.1	B	0.0	B	93.9	B
Government information or internet services	34.7	E	22.4	E	61.2	E
Government support for training	6.1	B	8.2	E	85.7	E
Rail transportation						
Research and development (R&D) tax credits	6.7	E	6.7	E	93.3	E
Government research and development (R&D) grants	6.7	E	0.0	B	93.3	E
Government venture capital support	0.0	B	0.0	B	100	B
Government technology support and assistance programs	0.0	B	0.0	B	100	B
Government information or internet services	33.3	E	20.0	E	66.7	E
Government support for training	0.0	B	13.3	E	86.7	E
Water transportation						
Research and development (R&D) tax credits	2.1	B	0.0	B	97.9	B
Government research and development (R&D) grants	2.1	B	2.1	B	97.9	B
Government venture capital support	0.0	B	0.0	B	100	B
Government technology support and assistance programs	2.1	B	0.0	B	97.9	B
Government information or internet services	22.9	E	14.6	E	77.1	E
Government support for training	6.3	B	22.9	E	75	E
Truck transportation						
Research and development (R&D) tax credits	1.0	B	0.0	B	99.0	B
Government research and development (R&D) grants	0.0	B	0.0	B	100	B
Government venture capital support	1.0	B	2.0	B	98.0	B
Government technology support and assistance programs	2.0	B	0.0	B	98.0	B
Government information or internet services	30.7	E	30.7	E	63.4	E
Government support for training	10.9	E	8.9	E	84.2	E

Table 15A (con't): Percentage of innovative establishments that used programs sponsored by the federal or provincial/territorial governments, 2001 to 2003

	Government programs					
	Federal government		Provincial/ territorial government		Did not use government program	
	%	Reliability	%	Reliability	%	Reliability
Interurban and rural bus transportation						
Research and development (R&D) tax credits	0.0	B	0.0	B	100	B
Government research and development (R&D) grants	0.0	B	0.0	B	100	B
Government venture capital support	0.0	B	0.0	B	100	B
Government technology support and assistance programs	0.0	B	0.0	B	100	B
Government information or internet services	0.0	B	25.0	E	75.0	E
Government support for training	0.0	B	F	F	F	F
Airport operations						
Research and development (R&D) tax credits	7.3	B	0.0	B	92.7	B
Government research and development (R&D) grants	0.0	B	0.0	B	100	B
Government venture capital support	7.3	B	0.0	B	92.7	B
Government technology support and assistance programs	9.8	B	2.4	B	90.2	B
Government information or internet services	36.6	E	22.0	E	63.4	E
Government support for training	4.9	B	4.9	B	92.7	B
Port and harbour operations						
Research and development (R&D) tax credits	3.4	B	0.0	B	96.6	B
Government research and development (R&D) grants	0.0	B	0.0	B	100	B
Government venture capital support	0.0	B	0.0	B	100	B
Government technology support and assistance programs	0.0	B	0.0	B	100	B
Government information or internet services	41.4	B	31.0	B	58.6	B
Government support for training	3.4	B	3.4	B	93.1	B

Table 16A: Percentage of innovative establishments that agreed on impacts from new or significantly improved products (goods or services) or processes developed and introduced, 2001 to 2003

	Agree		Strongly agree		Not relevant	
	%	Reliability	%	Reliability	%	Reliability
Air transportation						
Increased the business unit's productivity	55.6	E	44.4	E	11.1	B
Increased the speed of supplying and/or delivering services or goods	55.6	E	22.2	B	11.1	B
Increased the ability to adapt flexibly to different client demands	55.6	E	16.7	B	11.1	B
Allowed business unit to keep up with its competitors	66.7	E	44.4	E	0.0	A
Improved the quality of products (goods or services)	77.8	B	27.8	E	11.1	B
Rail transportation						
Increased the business unit's productivity	62.5	E	12.5	B	0.0	A
Increased the speed of supplying and/or delivering services or goods	12.5	B	0.0	A	12.5	B
Increased the ability to adapt flexibly to different client demands	50.0	E	12.5	B	0.0	A
Allowed business unit to keep up with its competitors	62.5	E	12.5	B	0.0	A
Improved the quality of products (goods or services)	25.0	E	12.5	B	0.0	A
Water transportation						
Increased the business unit's productivity	100	A	40.0	E	0.0	A
Increased the speed of supplying and/or delivering services or goods	70.0	E	40.0	E	10.0	B
Increased the ability to adapt flexibly to different client demands	50.0	E	12.5	B	0.0	A
Allowed business unit to keep up with its competitors	40.0	E	30.0	E	0.0	A
Improved the quality of products (goods or services)	60.0	E	50.0	E	30.0	E
Truck transportation						
Increased the business unit's productivity	50.0	E	15.4	B	11.5	B
Increased the speed of supplying and/or delivering services or goods	42.3	E	15.4	B	26.9	E
Increased the ability to adapt flexibly to different client demands	61.5	E	11.5	B	11.5	B
Allowed business unit to keep up with its competitors	57.7	E	26.9	E	11.5	B
Improved the quality of products (goods or services)	50.0	E	23.1	E	11.5	B
Interurban and rural bus transportation						
Increased the business unit's productivity	0.0	A	0.0	A	14.3	E
Increased the speed of supplying and/or delivering services or goods	42.9	E	0.0	A	14.3	E
Increased the ability to adapt flexibly to different client demands	85.7	E	0.0	A	14.3	E
Allowed business unit to keep up with its competitors	42.9	E	0.0	A	14.3	E
Improved the quality of products (goods or services)	42.9	E	0.0	A	14.3	E
Airport operations						
Increased the business unit's productivity	63.2	B	26.3	B	15.8	B
Increased the speed of supplying and/or delivering services or goods	63.2	B	15.8	B	10.5	B
Increased the ability to adapt flexibly to different client demands	57.9	B	21.1	B	15.8	B
Allowed business unit to keep up with its competitors	26.3	B	21.1	B	31.6	B
Improved the quality of products (goods or services)	73.7	B	36.8	B	15.8	B
Port and harbour operations						
Increased the business unit's productivity	75.0	A	33.3	A	0.0	A
Increased the speed of supplying and/or delivering services or goods	58.3	B	25.0	A	8.3	A
Increased the ability to adapt flexibly to different client demands	75.0	A	41.7	B	0.0	A
Allowed business unit to keep up with its competitors	75.0	A	8.3	A	0.0	A
Improved the quality of products (goods or services)	66.7	A	16.7	A	0.0	A

Table 17A: Percentage of non-innovative establishments indicating reasons why they did not develop or introduce any new or significantly improved products (goods or services) or processes, 2001 to 2003

	Carried out prior to 2001-2003		No market demand		Lack of funds	
	%	Reliability	%	Reliability	%	Reliability
Air transportation	45.2	E	58.1	E	41.9	E
Rail transportation	F	F	F	F	14.3	E
Water transportation	28.9	E	73.7	E	26.3	E
Truck transportation	18.7	E	64	E	38.7	E
Interurban and rural bus transportation	F	F	F	F	F	F
Airport operations	18.2	E	86.4	E	27.3	E
Port and harbour operations	41.2	B	70.6	B	29.4	B

Table 17A (con't): Percentage of non-innovative establishments indicating reasons why they did not develop or introduce any new or significantly improved products (goods or services) or processes, 2001 to 2003

	Lack of trained staff		Other reasons	
	%	Reliability	%	Reliability
Air transportation	12.9	E	0.0	B
Rail transportation	F	F	14.3	E
Water transportation	31.6	E	5.3	B
Truck transportation	26.7	E	17.3	E
Interurban and rural bus transportation	F	F	F	F
Airport operations	18.2	E	9.1	E
Port and harbour operations	0.0	B	11.8	B

Appendix III: Overview of transportation industries

This part of the paper is intended to provide further information and context for the selected transportation industries that were covered by the Survey of Innovation 2003. This includes information on their share of GDP, levels of employment, wages and salaries and the performance of R&D. Information is provided at the most detailed levels available. Occasionally this corresponds to the industries as surveyed but sometimes the selected industries are included in a larger group.

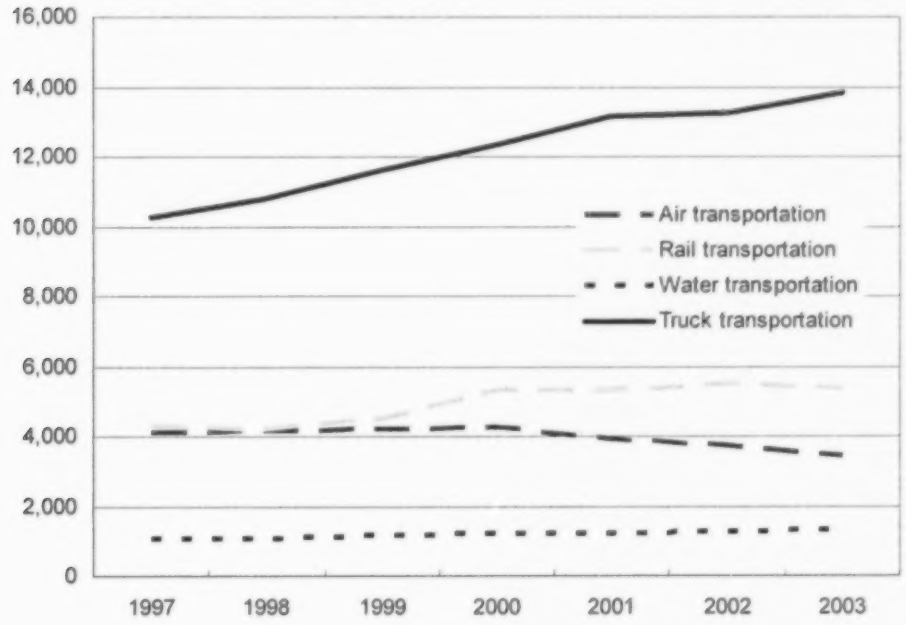
Under the North American Industry Classification System (NAICS), the transportation sector comprises eight industry groups. Complete data for value-added, employment and wages are available for four of these industry groups: "Air transportation", "Rail transportation", "Water transportation" and "Truck transportation". For the other three selected transportation industries, data are more limited. No data are available for GDP but complete employment and wage and salary data are available for "Interurban and rural bus transportation". Employment and wage and salary data for "Airport operations" is available only as included in "Support activities for air transportation" and similarly, for "Port and harbour operations" data are part of "Support activities for water transportation".

Gross Domestic Product (GDP or value-added)

Transportation industries as a whole (NAICS 48) accounted for 4.0% of Canadian GDP in 2003[19]. The selected transportation industries covered by the Survey of Innovation 2003, represented approximately 3.6% of GDP[20]. While there was strong growth in "Truck transportation" and to a lesser extent in "Rail transportation" and "Water transportation", the real value-added of "Air transportation" fell between 1997 and 2003 (Figure A1).

Figure A1
Value-added of selected transportation industries, 1997-2003

(millions of constant value 1997 dollars)



Source: *Statistics Canada*

19. Source: CANSIM Table 379-0017, Gross Domestic Product at Basic Prices
20. Note that this grouping includes all of NAICS 485 (Transit and Ground Passenger Transportation,) not just 4852 (Interurban and Rural Bus Transportation).

Employment

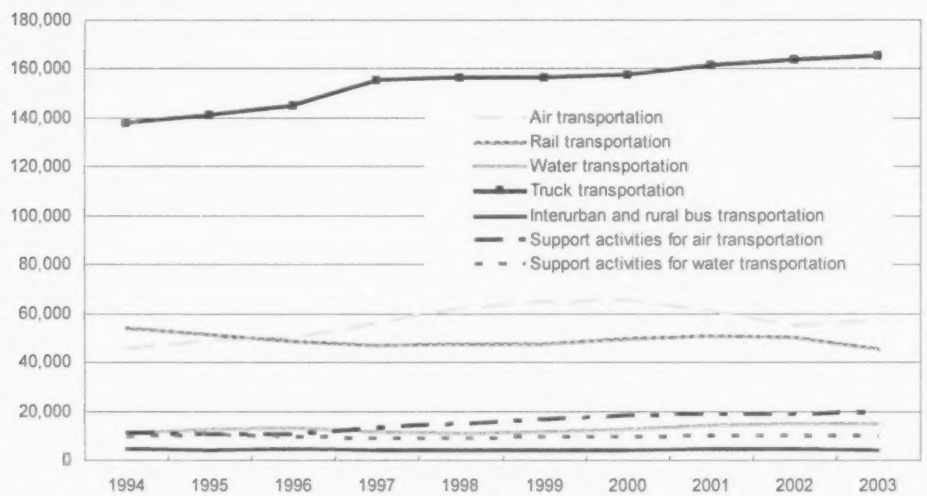
Employment in all transportation industries accounted for a similar proportion of all employment in 2003, 3.5% of the total workforce[21]. Selected transportation services covered by the Survey of Innovation 2003 accounted for approximately two-thirds of all transportation employees. Of the selected transportation industries, the largest employer was "Truck transportation", followed by "Air transportation" and "Rail transportation". Employment in the selected transportation industries grew between 1994 and 2000 and then remained stable through 2003 (Figure A2).

Employment in "Air transportation" grew rapidly between 1994 and 2000, but then fell in 2001 to 2003. Employment in support activities for "Air transportation", by contrast, reported the highest rate of growth of all the selected transportation industries, almost doubling from 10,950 to 19,274 between 1994 and 2003.

The number of employees in "Water transportation" grew slowly over the 10 year interval, while in "Support activities for water transportation", employment remained virtually unchanged. "Interurban and rural bus transportation" employment also remained constant.

"Truck transportation" reported steady growth in employment and the largest overall number of new jobs while employment in "Rail transportation" was somewhat lower in 2003 than 1994.

Figure A2
Employment in selected transportation industries, 1994-2003



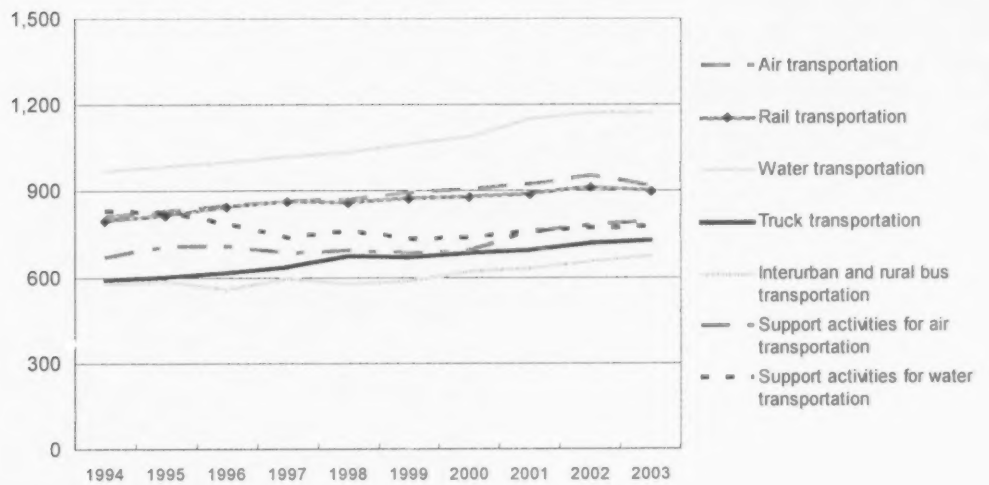
Source: *Statistics Canada*

21. Source: CANSIM Table 281-0024, Survey of Employment, Payroll and Hours

Wages and salaries

Average weekly earnings in all of the selected transportation industries were higher than average weekly earnings across the economy and in the service sector overall[22] (Figure A3). The highest average weekly earnings were reported by employees in "Water transportation", followed by "Air transportation" and "Rail transportation". This represented a shift from ten years earlier, when support activities for "Water transportation" reported the second highest average weekly earnings. "Interurban and rural bus transportation" consistently reported the lowest average weekly earnings and "Truck transportation" the second lowest.

Figure A3
Average weekly earnings in selected transportation industries, 1994-2003



Source: *Statistics Canada*

22. Source: CANSIM Table 281-0027, Average weekly earnings

Performance of Research and Development (R&D)

The transportation sector reported quite low levels of R&D spending between 1994 and 2003, in the range of $10 to 30 million per year or approximately 0.2% of all industrial R&D (Table A1). This is dwarfed by the spending of manufacturers of transportation equipment including motor vehicles, aerospace and rail and shipping equipment. Together, these three manufacturing industries account for over $1 billion of R&D spending per year since 1997[23]. The transportation sector is, however, able to benefit from the results of R&D conducted by transportation manufacturers, through the purchase of new equipment.

Table A1: Industrial R&D spending in transportation-related industries, 1994-2003 ($ millions)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Motor vehicles and parts	211	179	167	229	213	303	380	351	350	307
Aerospace products and parts	606	719	758	1,051	1,118	1,129	883	946	900	883
All other transportation equipment	3	6	7	13	25	20	23	25	14	14
Transportation	22	19	10	16	21	22	29	26	24	23
All transportation-related industries	842	923	942	1,309	1,377	1,474	1,315	1,348	1,288	1,227
All industries	**7,567**	**7,991**	**7,999**	**8,742**	**9,686**	**10,403**	**12,347**	**13,848**	**12,383**	**12,344**

Source: *Statistics Canada, RDCI database, 2004.*

23. Further information on industrial R&D can be found in Statistics Canada's publication, *Industrial Research and Development, 2004 Intentions*, Cat. No. 88-202-XIE, Table 3.

Catalogued publications

Statistical Publications

88-001-XIE Science Statistics (monthly)

88-202-XIE Industrial Research and Development, 2004 Intentions, (with 2003 preliminary estimates and 2002 actual expenditures)) (annual)

88-204-XIE Federal Scientific Activities, 2003-2004 (annual)

Volume 29

No. 1 Distribution of federal expenditures on science and technology by province and territories, 2002-2003 (January 2005)

No. 2 Research and development (R&D) personnel in Canada, 1993 to 2002 (May 2005)

No. 3 Biotechnology scientific activities in federal government departments and agencies, 2003-2004 (May 2005)

No. 4 Industrial Research and Development, 2001 to 2005 (June 2005)

No. 5 Estimates of total spending on research and development in the health field in Canada, 1988 to 2004 (July 2005)

Volume 28

No. 1 Estimation of research and development expenditures in the higher education sector, 2001-2002 HERD (January 2004)

No. 2 Total spending on research and development in Canada, 1990 to 2003 and provinces, 1990 to 2001 GERD (January 2004)

No. 3 Distribution of federal expenditures on science and technology, by province and territories, 2001-2002 (February 2004)

No. 4 Research and development (R&D) expenditures of private non-profit (PNP) organizations, 2002 (April 2004)

No. 5 The provincial research organizations, 2001 (May 2004)

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No. 7 Biotechnology scientific activities in selected federal government departments and agencies, 2002-2003 (July 2004)

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No. 9 Industrial research and development, 2000 to 2004 (August 2004)

No. 10 Estimation of research and development expenditures in the higher education sector, 2002-2003 (November 2004)

No. 11 Federal government expenditures on scientific activities, 2004-2005^{p} (November 2004)

No. 12 Total spending on research and development in Canada, 1990 to 2004^{p}, and provinces, 1990 to 2002 (December 2004)

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ST-05-07 Summary: Meeting on Commercialization Measurement, Indicators, Gaps and Frameworks, Ottawa (December 2004)

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ST-05-10 Access to Financing Capital by Canadian Innovative Biotechnology Firms (April 2005)

ST-05-11 Scientific and technological (S&T) activities of provincial governments and provincial research organizations, 1995-96 to 2003-04 (September 2005)

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ST-05-13 Innovation in Selected Professional, Scientific and Technical Services: Results from the Survey of Innovation 2003 (October 2005)

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ST-04-02 Estimation of research and development expenditures in the higher education sector, 2001-2002 (January 2004)

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